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ON-SITE SURVEY OF CANDIDATE SOLAR/ELECTRIC POWER PLANT SITES

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16. Abstract

This report describes an on-site survey of five candidate solar/electric power station sites in four California locations: Searles, Inyokern, Manix, and Blythe (two sites). The purpose of this report is to document the survey with sufficient observational data and photographs to help determine which of the above sites is best suited for a solar/electric power generating plant. The survey verified that Inyokern South is the best suited of the sites examined. This opinion is based on the degree that this site satisfied general requirements related to such observable criteria as water supply, land area and topography, land use, transmission lines (access to), transportation means, ground conditions, flora and fauna, and aesthetics. The results of a previous study were thus verified in which the Inyokern South site was ranked first, based on a paper analysis of all available site selection criteria including climate and insolation.

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June 1974

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Prepared for:

National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio 44135

Contract No. NAS3-18014

Dynamic Conversion of Solar-Generated
Heat to Electricity

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FOREWORD

The site survey undertaken and reported in this document satisifies, in part, the requirements of Task 1. 3, Additional Data, described in the contract Statement of Work. This task was to be performed in the event that data of Task 1. 2, Evaluation, were deemed inadequate as a firm basis for selecting a preferred site. The survey verified that all significant site selection criteria were considered and that the preferred site for a solar/electric power plant previously selected was valid.

Members of the survey team who participated in the survey and who provided valuable input to this report are identified below. The author, R. W. Palm, is particularly indebted to Dr. Charles Grosskreutz and Messrs. Ron Wood and John Vines of Black & Veatch Consulting Engineers who provided an abundance of data as well as a thorough critique of the manuscript.

Survey Team

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SECTION I
INTRODUCTION

This report describes an on-site survey of five candidate solar/electric power station sites in four California locations. These sites are identified as follows:

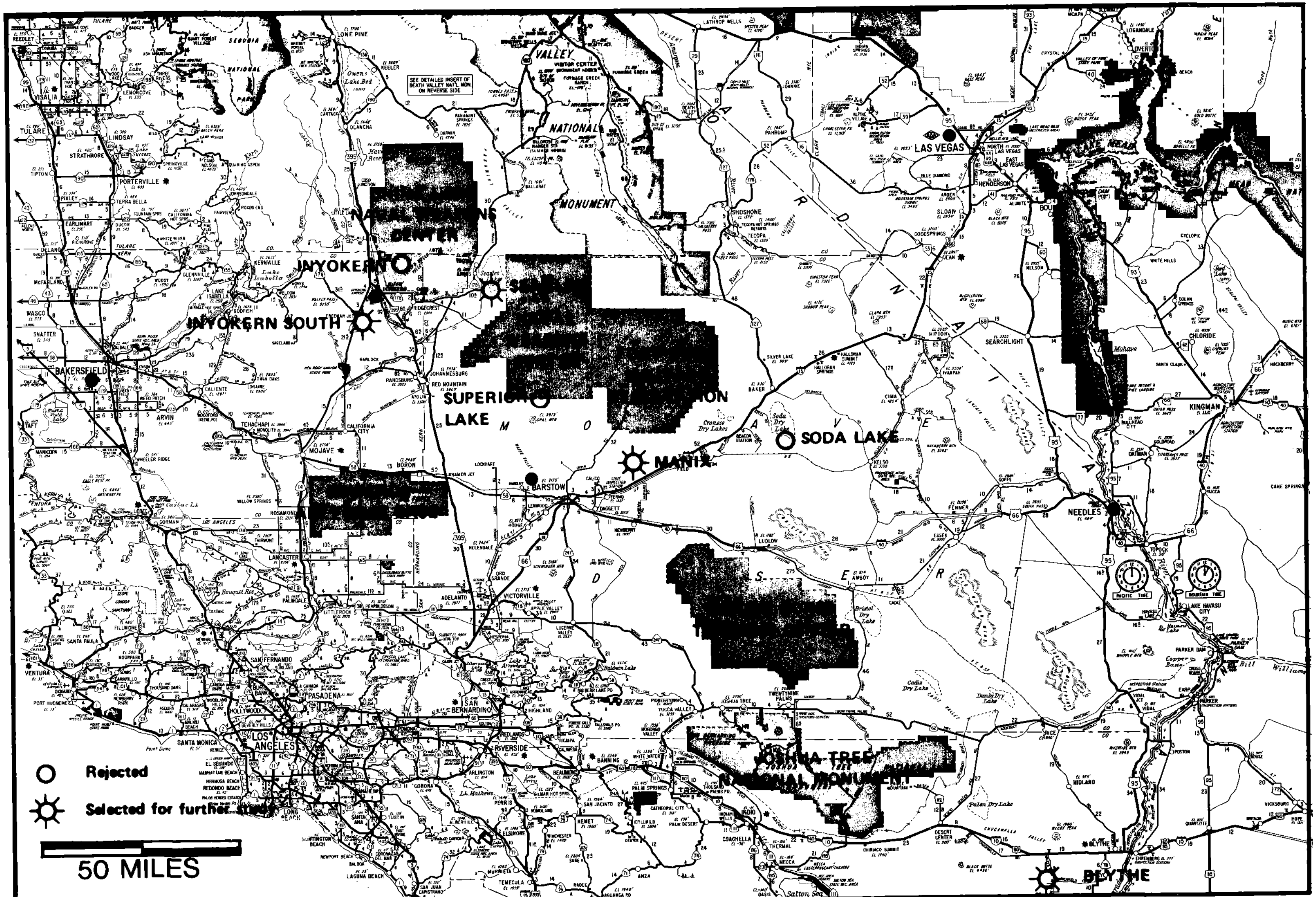
- Searles Lake (dry)
- Inyokern South
- Manix
- Blythe North
- Blythe South

Figure 1 shows the general location of all sites.

SUMMARY

The survey verified that Inyokern South is the best suited of the sites examined for a solar/electric power station. This opinion is based on the degree that Inyokern South satisfied general requirements related to such <u>observable</u> criteria as:

- Water supply
- Land area and topography
- Land use
- Transmission lines (access to)
- Transportation means (highways, railroads)
- Ground conditions (soils, geography)
- Flora and fauna
- Aesthetics



NASA LEWIS SOLAR/ELECTRIC POWER
Honeywell/Black & Veatch

Figure 1. Primary siting area

Favorable climatic conditions and the availability of high annual solar insolation were assumed for all sites. In previous reports,[1,2] Inyokern South was ranked first based on a comparative analysis of all the site selection criteria shown in Table 1.

REPORT PURPOSE

The purpose of this report is to document the survey with sufficient observational data and photographs to help determine which of the above sites is best suited for a solar/electric power generating plant.

REPORT FORMAT

Section I (this section) presents the summary and introductory information which sets the stage for the survey. Section II describes each site in words and photographs. Section III evaluates and compares the site data presented in Section II to identify conditions which would significantly influence the construction or operation of a solar/electric plant. Section IV presents conclusions regarding the analysis performed in Section III and represents the concensus of members of the survey team.

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1. Dynamic Conversion of Solar-Generated Heat to Electricity, Contract No. NAS3-18014, Monthly Technical Progress Narrative No. 2, Prepared for NASA-Lewis Research Center by Honeywell Systems & Research Center, 2600 Ridgway Parkway, Minneapolis, Minnesota, 15 November 1973.

2. Dynamic Conversion of Solar-Generated Heat to Electricity, Contract No. NAS3-18014, Site Selection Guide for Solar Thermal Electric Generating Plants, June 1974. (Copies may be obtained from Honeywell at the above address or Black & Veatch Consulting Engineers, P.O. Box 8405, Kansas City, Missouri 64114.)

Table 1. General Selection/Screening Criteria for Solar/ Electric Generating Station Sites

Criteria Description
1. Insolation and Meteorological Criteria 1.1 High insolation 1.2 Minimum interruption of insolation by clouds, fog, rain, inversion layers, blowing dust, etc.
2. Land Area and Topography Criteria 2.1 Meets area requirements of plant 2.2 Meets topography requirements of plant: a. Avoid shading by ridges adjacent to site. b. Seek relatively flat areas with good drainage. South-facing slopes are acceptable, especially for power-tower concept.
3. Land Use Criteria 3.1 Avoid urban areas, agriculturally productive areas, commercial, and industrial activities. 3.2 Avoid national, state, and local parks, American Indian land, wilderness areas, wildlife reserves, and sanctuaries. 3.3 Avoid proximity to airports and flight corridors.
4. Soils/Geology Criteria 4.1 Avoid dry lake playas, depressions, and areas of uncompacted sand and sand dunes. 4.2 Avoid areas containing active seismic faults.
5. Water Source Criteria 5.1 Water source meets requirements of plant, or potential water diversions are feasible.
6. Transportation Access Criteria 6.1 Access to site by paved highway or railroad should be possible with a minimum of secondary road improvement or spur construction.
7. Electric Transmission Criteria 7.1 Location of candidate sites should minimize the amount of construction of new transmission lines consistent with other siting constraints. (Sites for solar/electric plants of 300,000 kilowatts (electric) or larger should place more importance on proximity to load centers rather than existing transmission facilities.)

SURVEY OBJECTIVES

The prime objectives of this survey were to:

- Ascertain by personal observation that no factor which might significantly influence the selection of one site over another had been omitted from the list of site selection criteria previously generated.
- Verify that the Inyokern South side was indeed the best of five candidate sites for a solar/electric generating station (as determined by a preliminary site selection analysis).

Other objectives included providing the observers with (1) a total impression of the overall suitability of each site, (2) an opportunity to compare all candidate sites on the same day, and (3) further insight into solar/electric powerplant impact on ecology and aesthetics.

ITINERARY

The trip began at 7:00 a.m. on 10 December 1973, with take-off from Las Vegas Airport in a Honeywell Gulfstream turbo-prop 12-passenger plane. This plane affords good airborne viewability and is capable of cruising at the slower speeds desired for aerial photography. The itinerary was as follows:

- Lv. Las Vegas 7:00 a.m.; Arr. Inyokern 8:45 a.m. via Searles Lake (7:30 a.m.) and Inyokern South sites.
- Lv. Inyokern 11:45; Arr. Blythe 2:15 p.m. via Manix (12:30 p.m.) and the two Blythe plant sites.
- Lv Blythe 5:15; Arr. Las Vegas 6 p.m.

The two stops (Inyokern and Blythe) permitted ground reconnaissance at three sites. Searles and Manix were not examined on the ground.

WEATHER CONDITIONS ON DAY OF SURVEY

This entire area was influenced by a high-pressure cell centered over northeast Nevada. Except for Searles, where ground fog (or possibly low-lying smoke) was observed in the morning, visibility was unrestricted, and the ceiling was unlimited. Winds were calm to light (1 to 3 mph). Skies were cloudless. Temperatures ranged from the mid-thirties in the early morning to the high sixties by mid-afternoon.

SURVEY TEAM

The survey team included systems engineers and solar thermal scientists from Honeywell Inc. and power plant engineers and site selection experts from Black & Veatch Consulting Engineers.

DATA RECORDING METHODS

Team members photographed and/or recorded (in a notebook or hand-held tape recorder) their observations and impressions as each site was surveyed from the air and/or the ground. When the trip was completed, all notes, tapes, and photographs were collected and reviewed by the group for accuracy and unnecessary duplication. This report was then prepared summarizing the results.

SECTION II
SITE DESCRIPTIONS

SITE NO. 1: SEARLES, CALIFORNIA

As shown in Figure 1, Searles Lake, a 15-square-mile dry lake bed is located about 20 miles due east of China Lake, California. The Searles site (Figure 2) is situated just south of this lake bed in a 25-square-mile (5 x 5), fairly flat area (rising 15 feet per mile going south). It comprises about one-fifth of a north-south-oriented valley (closed at the north; open to the south) lying between two 6000-foot (above sea level) ranges: the Slate Range to the north and east and the Argus Range to the west. A geologic map shows the rock structure of the site to be predominantly Quaternary lake deposits. Soil conditions were not observable from the air. However, wind-blown alkali dust is expected to be a problem. A map of the area (Figure 2) shows the Searles Lake salt wells, pipeline, and abandoned sediment tanks, as well as the candidate site.

The photographic fly-by began at 7:30 a.m.. Starting at the northeast corner of the area, pictures were taken as the plane circled the area in a clockwise flight pattern. Figure 3, taken from the northeast corner of the area at an altitude of 6000 feet (7:30 a.m.), shows the salt wells, sediment tanks, and apparent potash processing plants lying just north of the site. Ground fog was observed in the foothills to the east. A smoke plume from an industrial operation to the south contributed to the fog condition, as did an apparent early morning temperature inversion.

Figure 4, taken at 1000 feet altitude as the southward-flying plane approached the southeast corner, shows a closer view of the sedimentation area. Figure 5 shows the Searles site as viewed from below the southern boundary (taken at 1000 feet altitude as the plane approached the southwest corner).

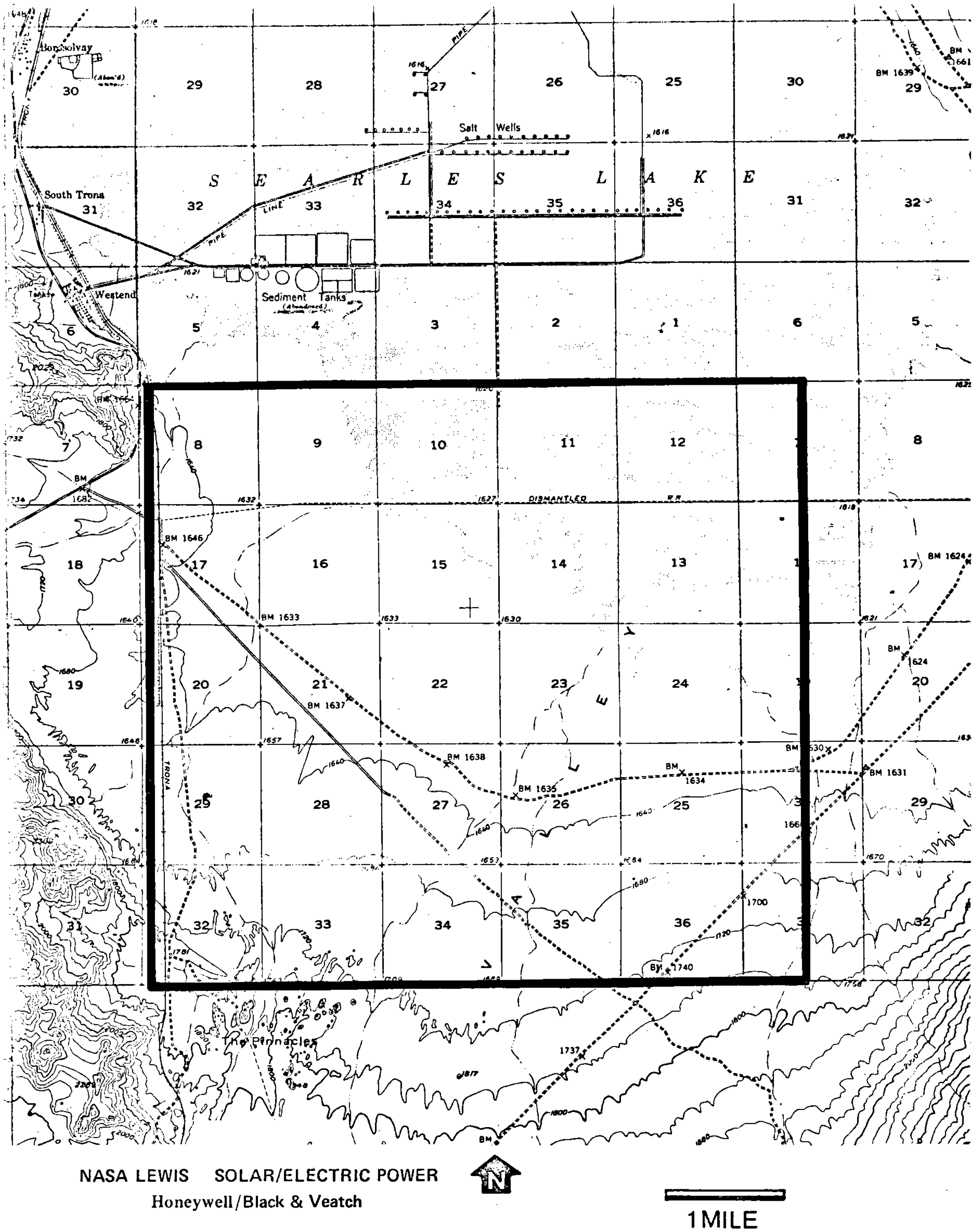

Figure 2. Searles site

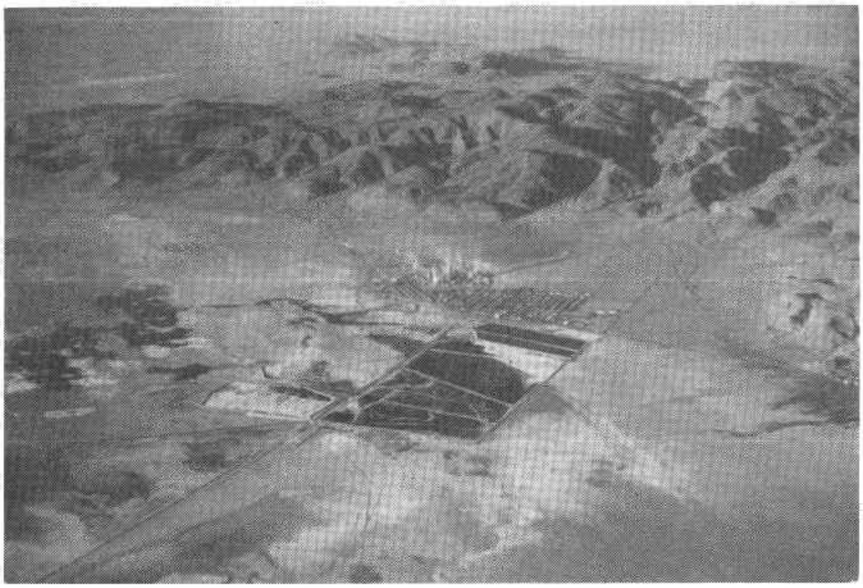

Figure 3. Looking Southwest Toward Westend, California. Smoke plumes arising from apparent potash processing plants can be seen in upper center of photo. Taken from altitude of 6000 feet.

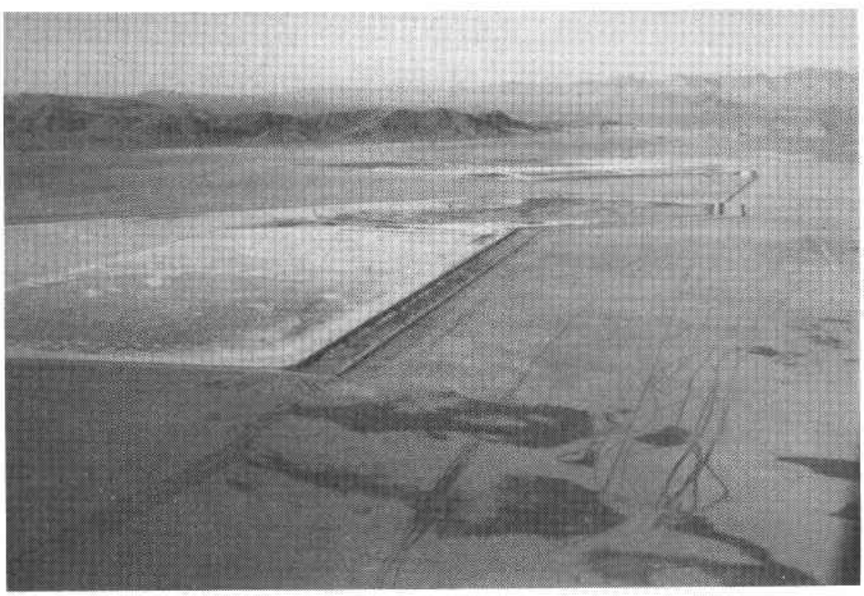

Figure 4. View of Searles site looking west from about halfway down the eastern boundary of the site, across sedimentation areas. Taken from altitude of 1000 feet.

Figure 5. View of Searles site looking north from southern boundary of site, across dry lake bed. Taken from altitude of 1000 feet.

SITE NO. 2: INYOKERN SOUTH

The northern edge of this 33-square-mile trapezoidal site (Figure 6) is situated approximately 5 miles southwest of the town of Inyokern, California. It is slightly bowl-shaped, rising at 150 feet per mile to both the Sierra Nevada Fault Zone to the northwest and to the El Paso Mountains to the southeast (Figure 7). No alluvial outwash from the mountains is apparent. Figures 8, 9, and 10 are aerial photographs taken at an altitude of 1000 feet at noon as the plane travelled from north to south along the eastern edge of the site.

Figure 10 shows the central portion of area as the plane flies southward over "Little Dixie Wash." Freeman Gulch may be seen oriented top to bottom (west to east) in the center of the picture. Sage Canyon may be seen in the upper left-hand corner.

Figure 11 shows the entire Inyokern South site as viewed from the south (taken at 9:15 a.m. at 3000 feet altitude). Highway 14, a major state highway (blacktop), can be seen extending north-northeastward. The picture emphasizes the flat and barren character of the entire area.

A ground shot of Highway 14 is shown in Figure 12 with the camera pointing north. This highway traverses the entire site from north-northeast to south-southwest (see Figure 11 also).

A southward view of the southwestern part of the area, west of the highway, is shown in Figure 13. Figure 14 shows the western portion of the area as viewed from the southwest corner of the site. The two Los Angeles aqueducts may be observed snaking northward along the slightly sloping terrain.

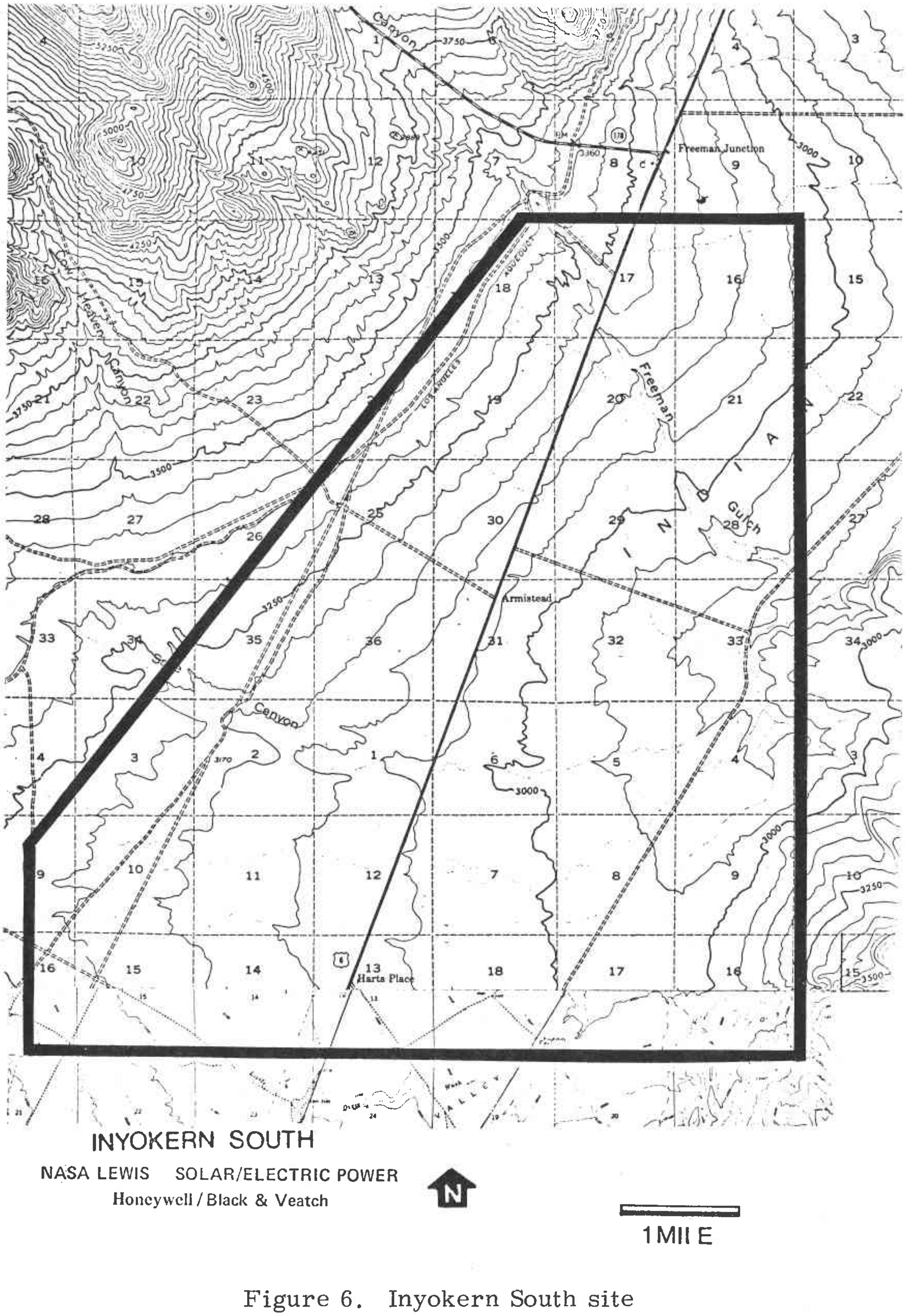

Figure 6. Inyokern South site

Figure 7. Inyokern South site as viewed from southern boundary of site. Taken at 9:15 a.m. from altitude of 3000 feet.

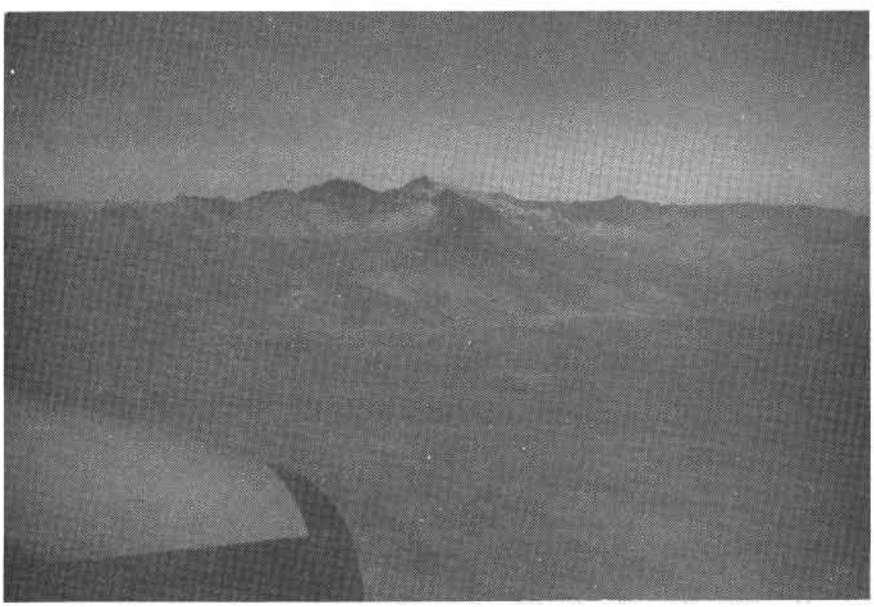

Figure 8. Northern portion of Inyokern South site (looking west from northeast corner of site)

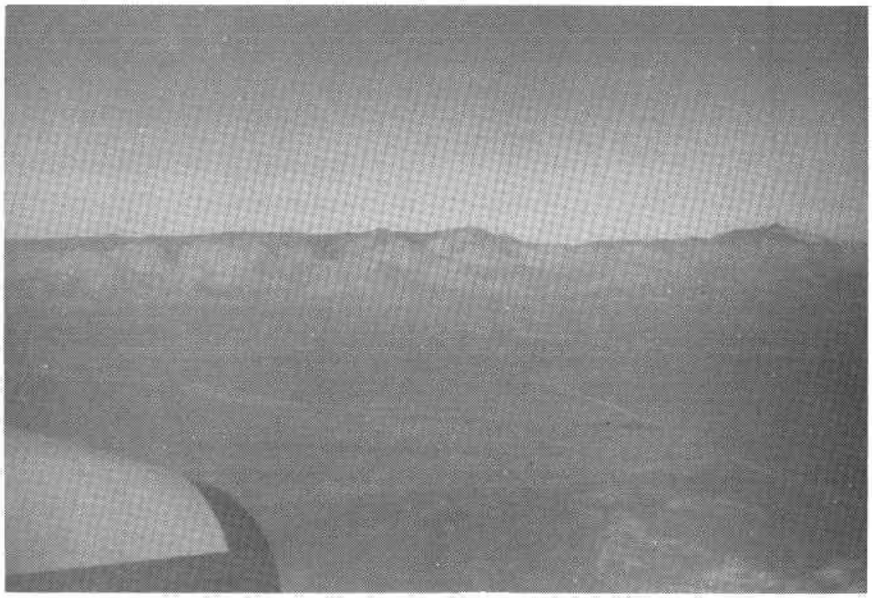

Figure 9. North-central portion of Inyokern South site (looking west from midway point of eastern edge of site)

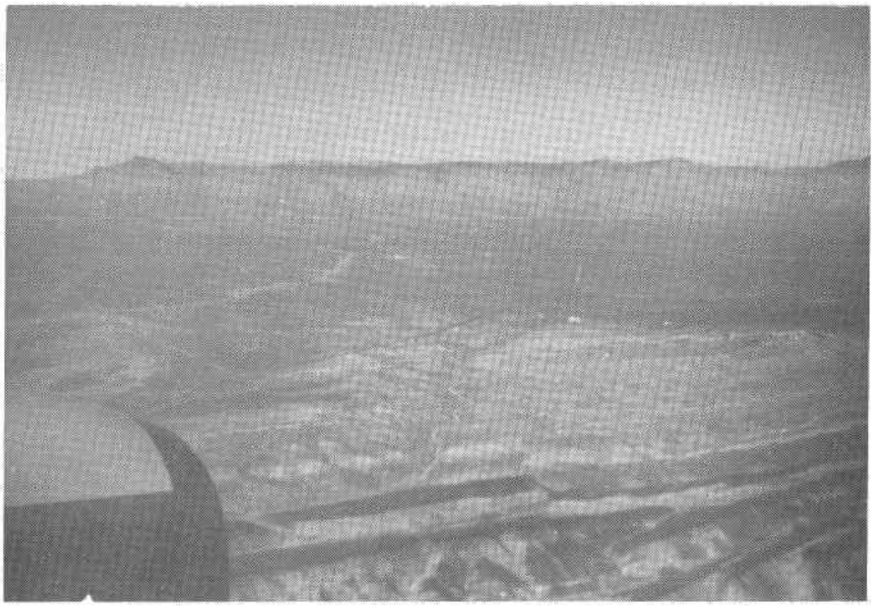

Figure 10. Central portion of Inyokern South site (looking northwest from southeast corner of site)

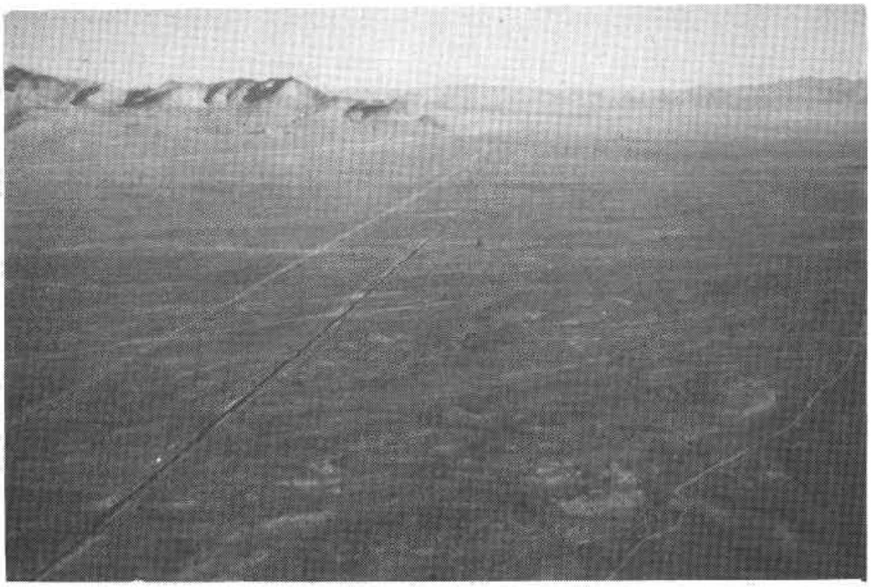

Figure 11. Inyokern South site (looking northwest)

Figure 12. Northern boundary of Inyokern South site (looking north)

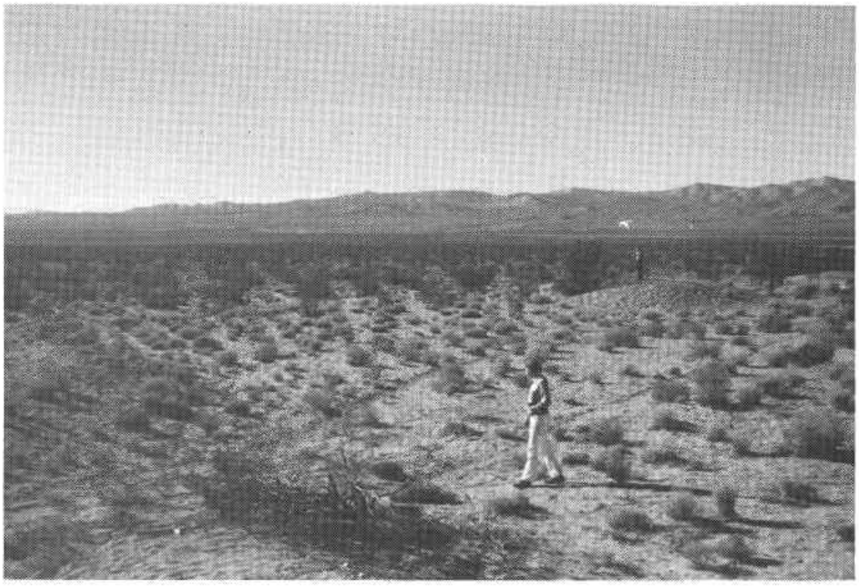

Figure 13. Inyokern South site (southwestern corner looking south-southeast)

Figure 14. View looking northwestward from southwestern corner of Inyokern South site. Taken from altitude of 3000 feet.

There is no development in the area except in the center where about 15 uninhabited residential structures (and a gas station) are located (Figure 15). A cattle pen was observed in the northeast portion of the site.

Two Los Angeles aqueducts (an old gravity-flow system and a newer pressurized system) cut across the western edge of the site. Mostly underground, they are visible in places. Figure 16 shows a portion of the newer aqueduct. At this point it is 7 feet in diameter and has a maximum flow capability of 273 cubic feet per second (123,000 gallons per minute).

These aqueducts are the only dependable source of surface water in the area. (Surface runoff from the surrounding mountains is sporadic.) Although allocations are probably not available from the system, a diversion contingent on returning the water to the system from the California aqueduct near Fairmont Reservoir is feasible.

A few dirt roads (Figures 17 and 18) also crisscross the area, but the ground appears to be firm enough to cut across country without benefit of roads. (However, cross-country travel is not advised due to damage to vegetation caused by wheeled vehicles.) Both AC and DC electric power transmission lines cross the site (Figures 18 and 19). An airfield is also convenient to the area -- within 5 miles of the site (Figure 20).

Rock types in the area are sedimentary Pleistocene nonmarine interrupted by alluvium in three small canyons traversing the area. Soil is mostly firm sand and gravel. (Sand storms occur mostly January through April with a probability of occurrence of about 0.003[3]--it requires a 30 to 40-mph wind to raise sand of this size.[4]) Vegetation consists of abundant scattered, but evenly distributed bushes averaging 1 to 2 feet in height (Figure 21) and

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3. From Summary of Meteorological Observations Surface (SMOS), Naval Weather Detachment, Ashville, N.C., for China Lake, Calif., during period 1945-1972.

4. AR705-15. Research and Development of Materiel: Operation and Development of Materiel under Extreme Climatic Conditions; subheading j, Blowing Sand, p. 19.

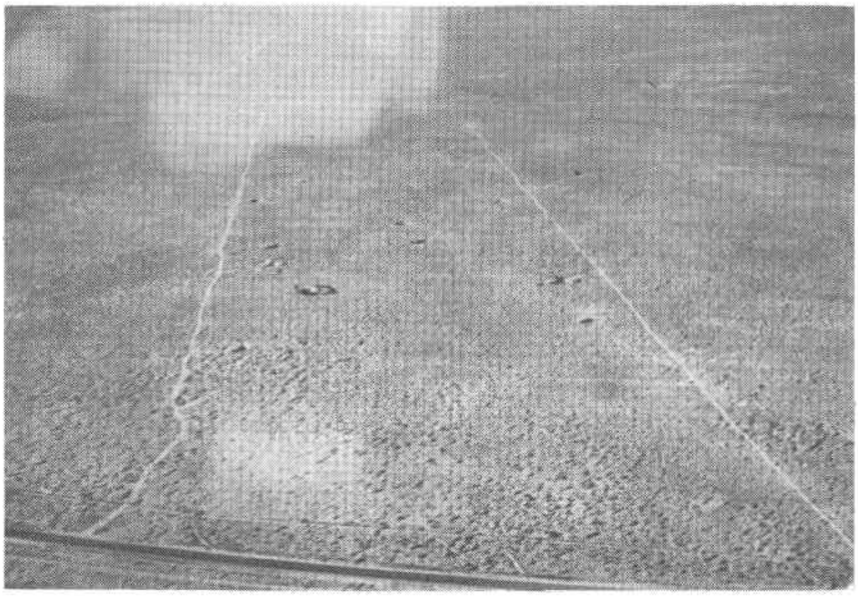

Figure 15. View of residential structures. Looking east at 1000 feet altitude. Highway 14 is visible at bottom of picture.

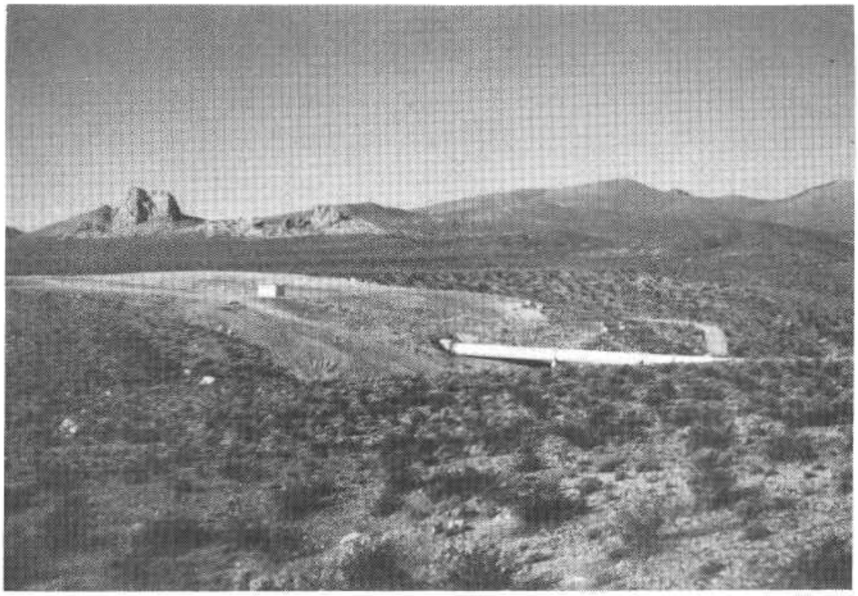

Figure 16. Looking west-southwest at newer Los Angeles aqueduct from northern boundary of Inyokern South site. Robber's Roost rock formation is in left background.

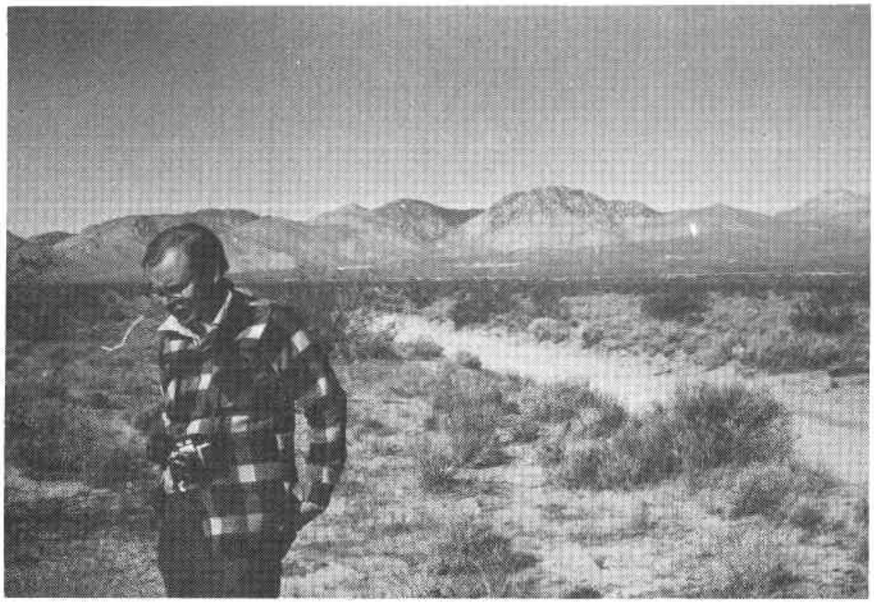

Figure 17. Southwestern view of Inyokern South site from southern boundary of area

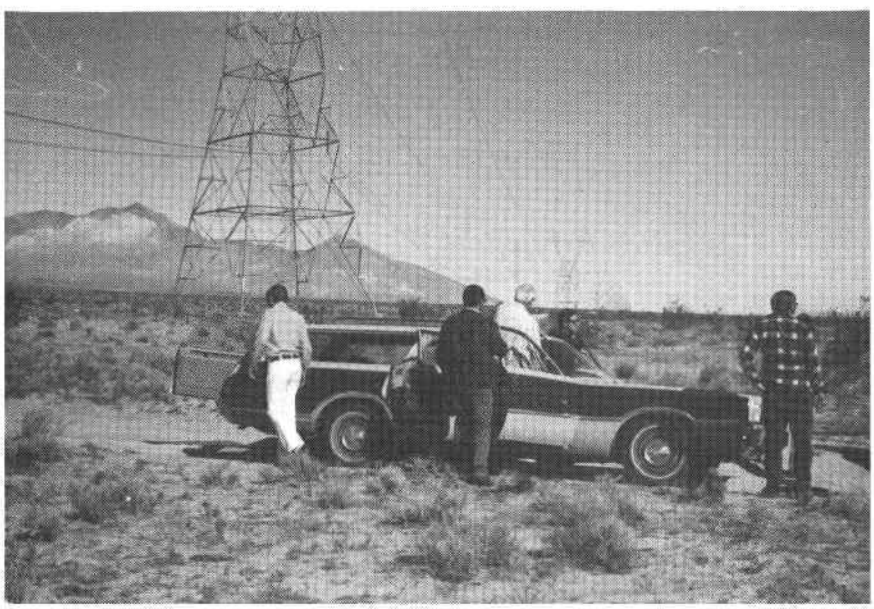

Figure 18. Northern view of Inyokern South site from southern boundary of area

Figure 19. Looking northeast from southern border of site. These lines consist of an 800-kv DC line (tall, single-pedestal tower) and a 231-kv AC line.

Figure 20. Inyokern Airport (looking west at noon)

Figure 21. East-northeast view of Inyokern South site taken from center of area. El Paso Mountains are in background.

occasional cacti and Joshua trees averaging 3 to 8 feet in height (Figures 22, 23, and 24). Dr. Carl Austin, a geologist at the nearby Naval Weapons Test Center, stated that it takes only four trips of wheeled vehicles across this type of vegetation to create a road, but that it takes 10 to 15 years for this vegetation to recover under normal rainfall conditions.

A typical Joshua tree is shown in Figure 24. This is a tall, branched, arborescent yucca endemic to southwestern U.S. Specimens are rare in this part of the site (southwest corner), being much more abundant in the southeastern corner. California law protects these trees.

There was little evidence of fauna in the area, but little time was available for searching. The apparent small animal hole shown in Figure 25 was discovered in the central part of the Inyokern South site.

Another area in the Inyokern area was examined briefly from the air. This area, located about seven miles south-southeast of the Inyokern South site (on the other side of the El Paso Mountains), is a flat, 9-square-mile area (3 x 3), lying in the northern part of the Fremont Valley. It is a dry lake bed (Koehn Lake) similar in appearance and composition (salt and Quaternary lake deposits) to Searles Lake. Figures 26 and 27 are aerial photographs of the area. Note the agricultural area and buildings in Figure 27. The Tehachapi Mountains are shown to the southwest.

Primarily because of this development and smog noted in the vicinity, this area was considered less suitable than the Inyokern South site. It was therefore not included as a viable candidate.

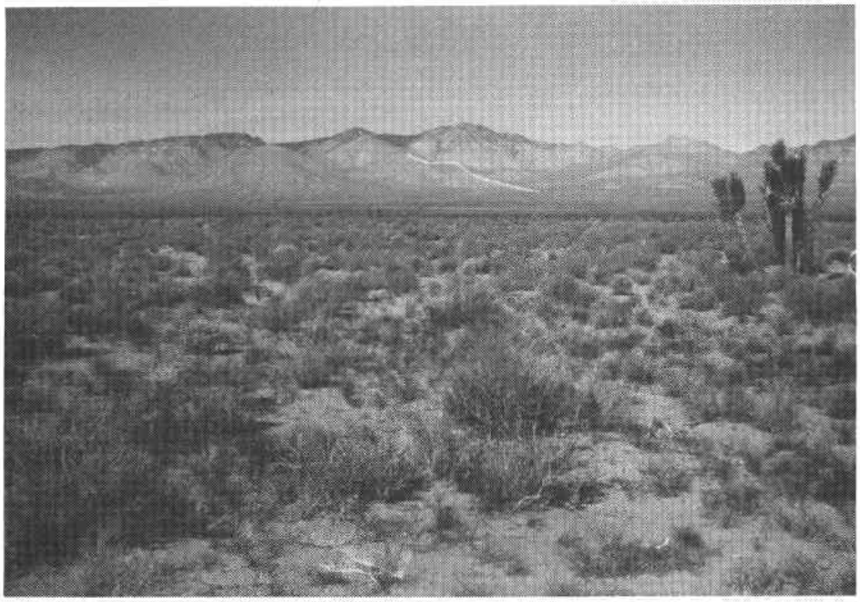

Figure 22. West-northwest view of Inyokern South site taken from center of area. The Sierra Nevadas loom in background.

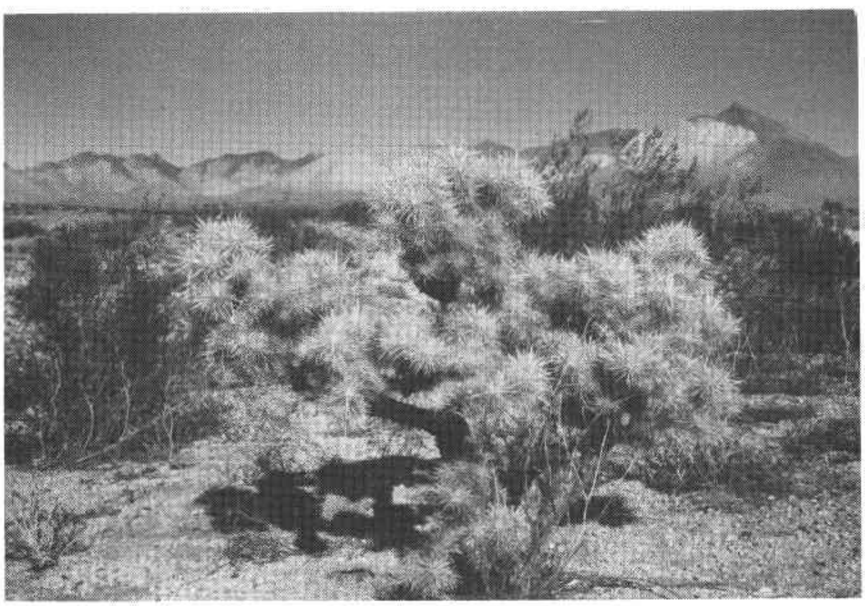

Figure 23. Cholla cactus (4 feet tall) in southwestern corner of Inyokern South site. View looking east.

Figure 24. View looking north from southwest corner of Inyokern South site

Figure 25. View of "rodent" hole located on site, possibly belonging to Mojave ground squirrel (an endangered species)

Figure 26. Northern part of Fremont Valley. View looking southwest toward town of Mojave. Notice low-lying fog or smog at base of San Andreas Mountains in distance.

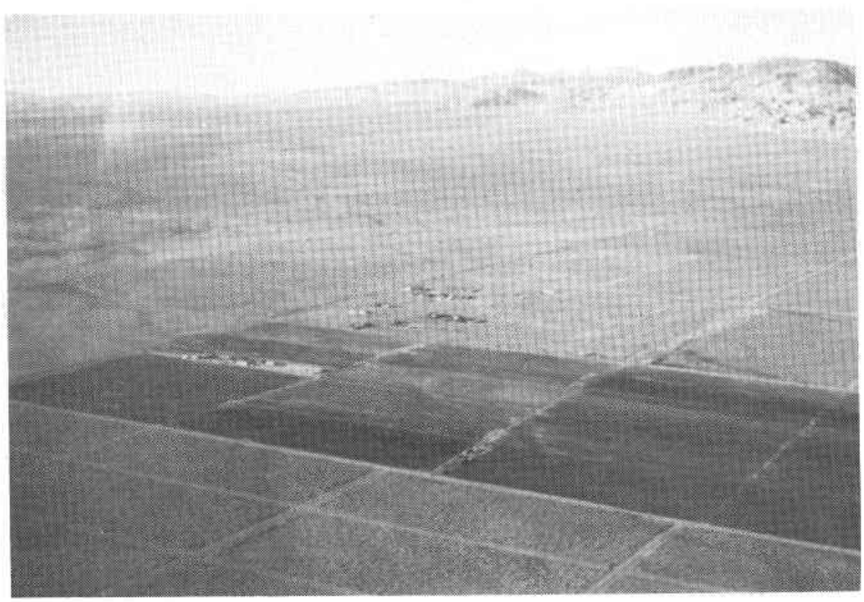

Figure 27. Better view of agricultural and developed area shown in Figure 26 (looking west)

SITE NO. 3: MANIX

The Manix site (Figure 28) is located about 5 miles north of Manix, California, and about 10 miles northeast of Barstow, California, both towns being on Interstate Highway 15. It is just south of a dry lake bed (Coyote Lake) composed of Quaternary lake deposits and alluvium. Some dune sand is present in the southwestern corner of the area. The terrain is very flat, rising only 9 feet per mile to the south. Elevation above sea level is about 1780 feet. Mountains surrounding the area average 3500 to 4000 feet above sea level.

Figures 29 through 32 are aerial photographs of the site taken from 3000 feet altitude as the plane circled the area clockwise beginning at the southwest corner. Figure 29 shows dune sand in the lower right-hand corner (southwest part of the site) and Coyote Lake (lighter-colored area) in the background. The mountains in the distance are the Paradise Range rising 2000 feet above the lake bed. In Figure 30, Coyote Lake lies to the north and is visible at the extreme left of the photograph.

Figures 31 and 32 show Coyote Lake from the northwest and southeast corners. Figure 32 shows evidence of development in the area. Coyote Lake can be seen in the background.

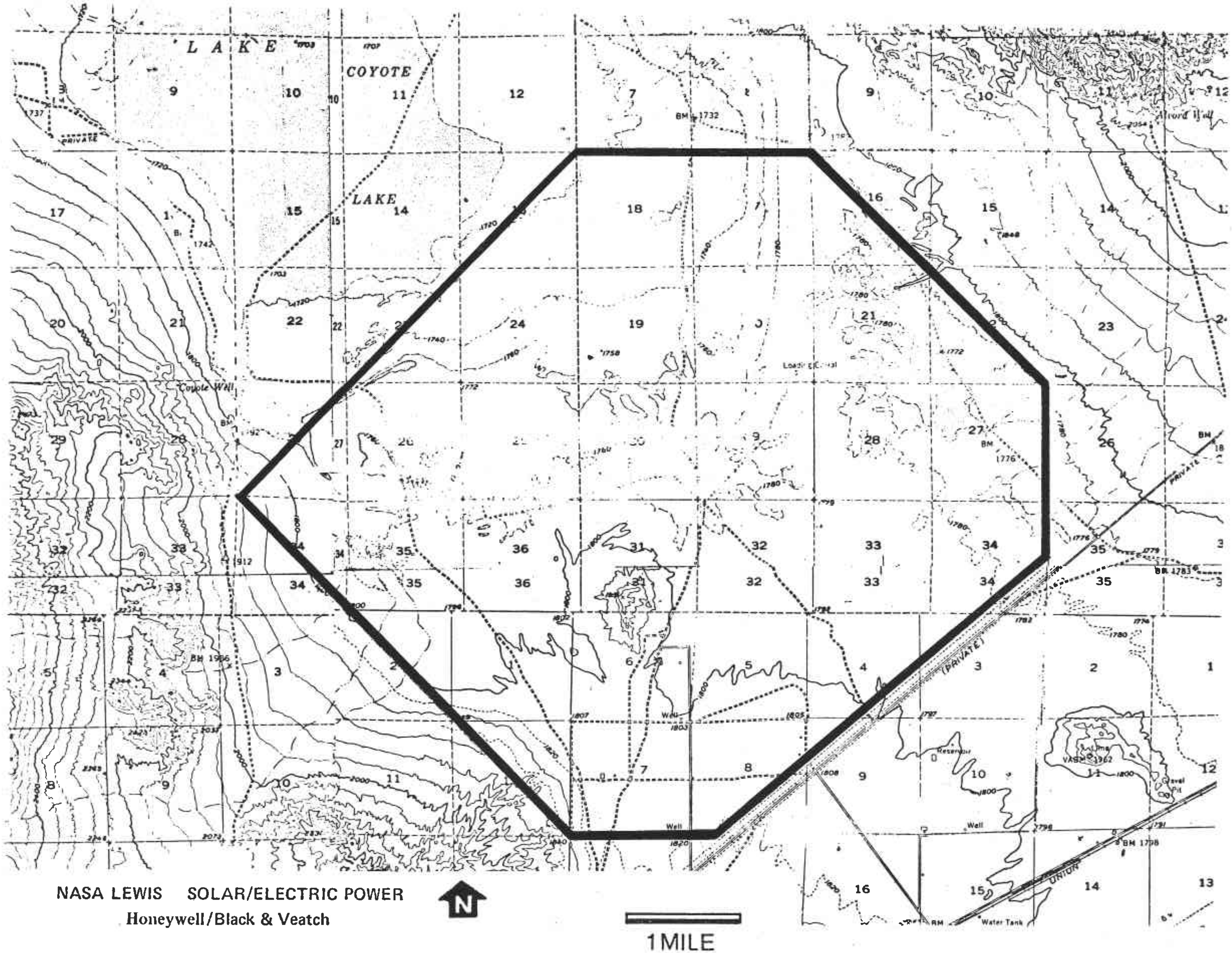

Figure 28. Manix site

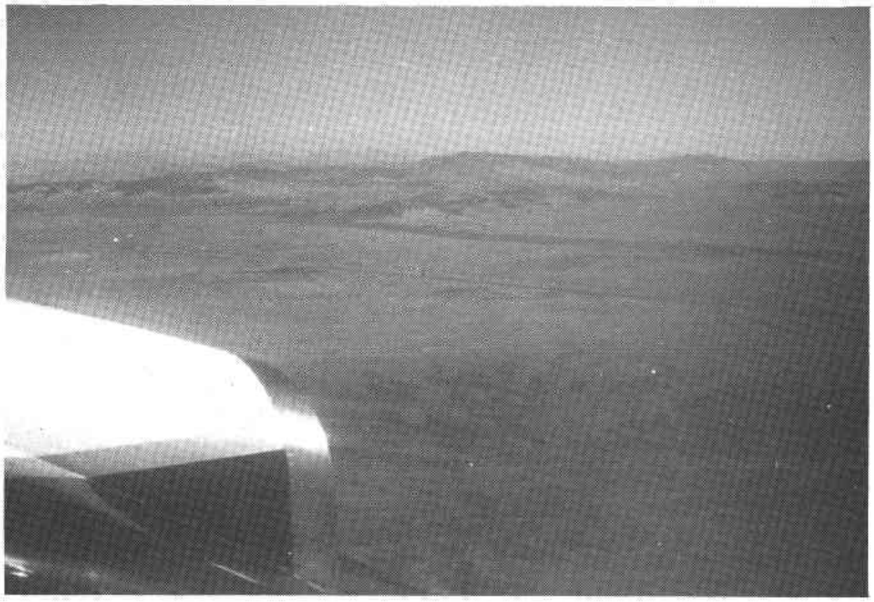

Figure 29. Eastern view of Manix site taken from southwest corner of area

Figure 30. View looking due east from west side of Manix site

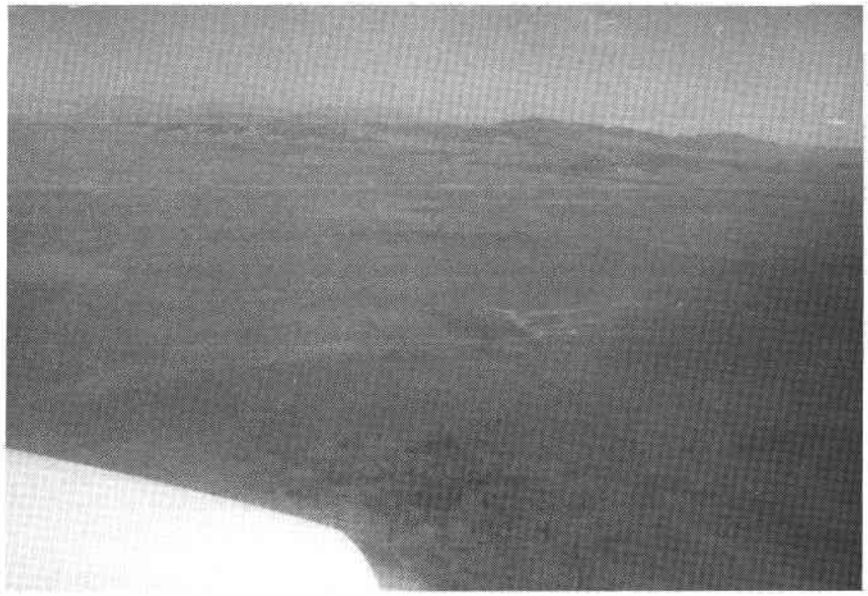

Figure 31. View from northwest corner of Manix site looking southeast

Figure 32. Northward view of Manix site taken from southeast corner. Taken from altitude of 3000 feet.

SITE NO. 4: BLYTHE NORTH

The Blythe North site (Figure 33) is located 25 miles west of Blythe, California, and about 5 miles north of Interstate Highway 10. This 25-square-mile area (5 x 5) is also fairly flat, rising at 105 feet per mile to the foothills of the Palen Mountains to the north. The mean elevation of the site is 450 feet above sea level.

Figures 34, 35, and 36 are aerial photographs taken at 3000 feet altitude (1:30 p.m.) as the plane circled the area clockwise. The three photographs were taken from the northeast corner, the southeast corner, and the southern edge, respectively. Dune sand characterizes the entire area. Vegetation is sparse except in numerous gullys (arroyos) radiating from the mountains (Figure 35). No development was observed on the site. Interstate Highway 10 is shown at the bottom right of Figure 36.

Ground reconnaissance of the site was attempted by traversing, by car, the 5 miles separating it from Highway 10. Three photographs were taken at a point 2 miles north of the highway along Chuckwalla Road. Figures 37, 38, and 39 show west, east, and north views, respectively. Note that dried mud flats and sand with widely scattered bushes characterize the area in the immediate vicinity of the car (Figures 37 and 38). Looking north (Figure 39), hard-packed sand predominates.

Four miles from the highway (1 mile south of the Blythe North site), loose sand prevented further access by car (Figure 40). Figure 41 shows a northward view of the site taken at this point. Sand and widely scattered bushes (mostly 2 to 3 feet and a few 6 to 8 feet in height) are main features.

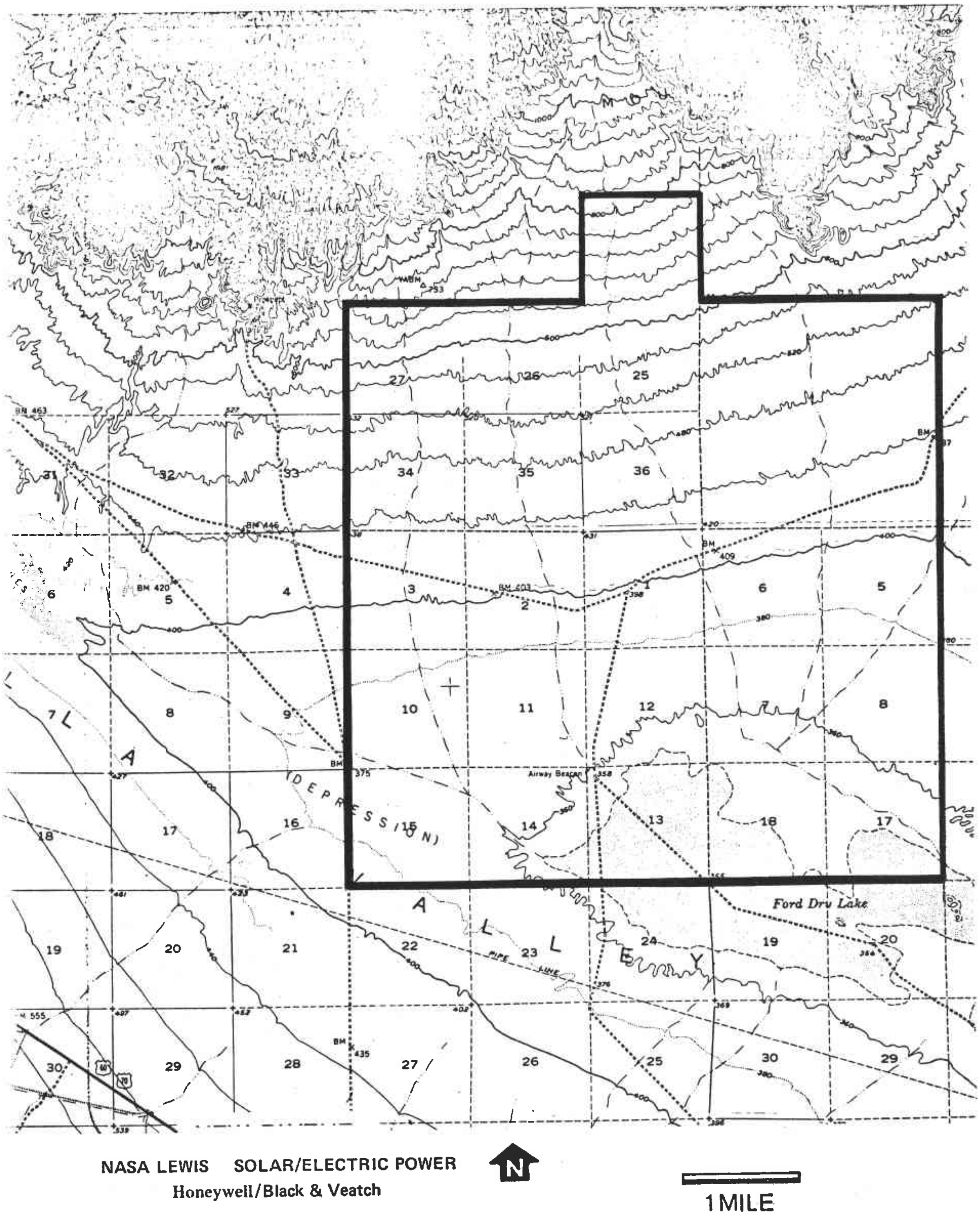

Figure 33. Blythe North site

Figure 34. View from northeast corner of Blythe North site looking west

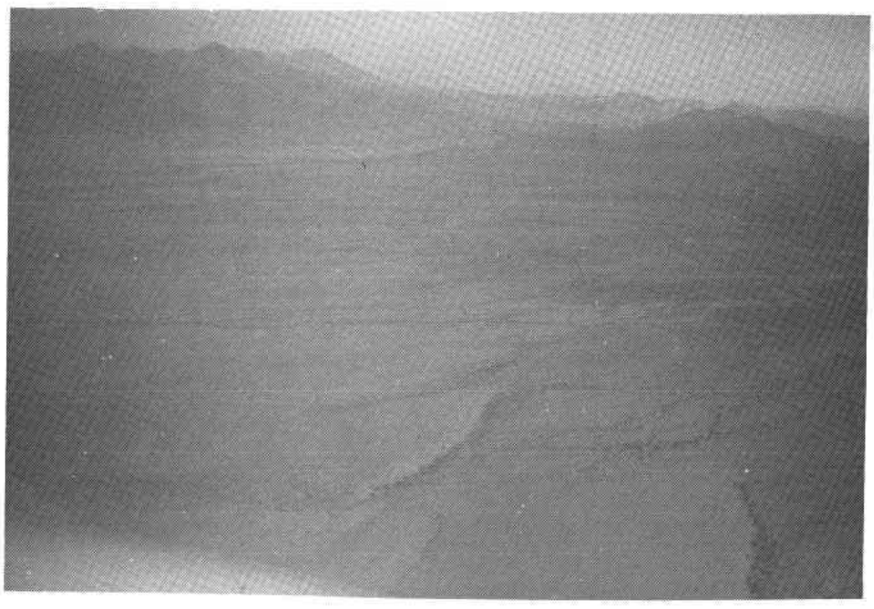

Figure 35. View from southeast corner of Blythe North site looking northwest

Figure 36. View from southern edge of Blythe North site looking north

Figure 37. View of southern approach to Blythe North site looking west

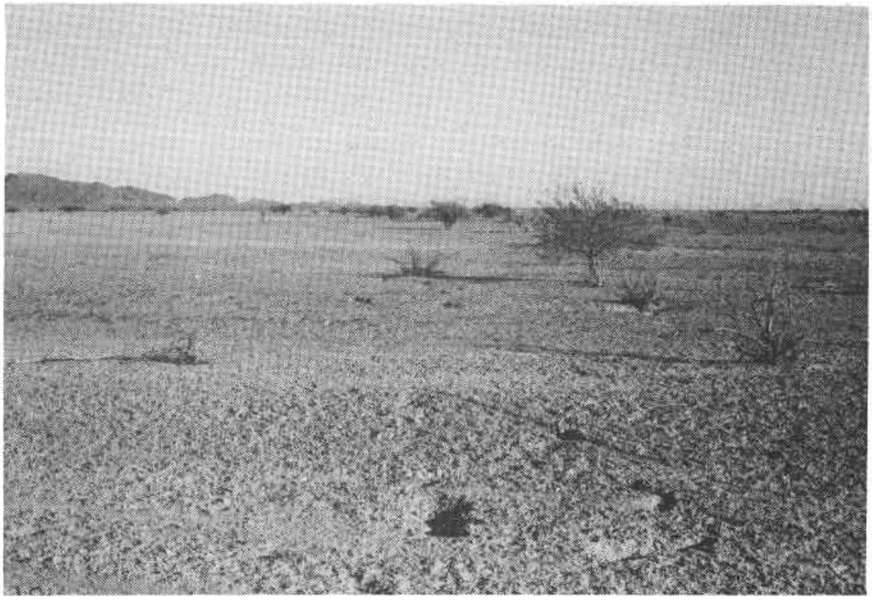

Figure 38. View of southern approach to Blythe North site looking east

Figure 39. View of southern approach to Blythe North site looking north. Site is 3 miles distant. Palen Mountains are in background.

Figure 40. The Chuckwalla Road Episode

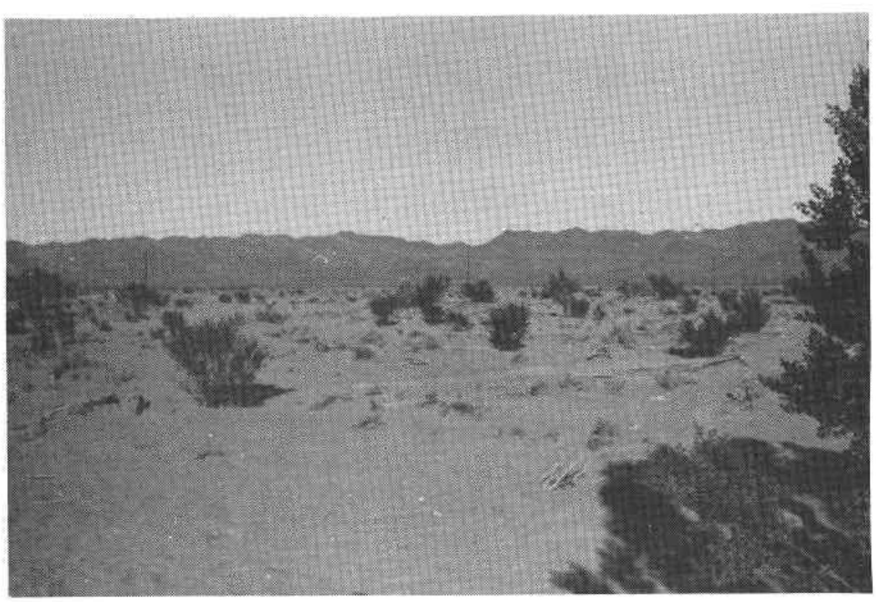

Figure 41. View of southern approach to Blythe North site looking north. Site is 1 mile distant.

SITE NO. 5: BLYTHE SOUTH

The Blythe South site (Figure 42) is located 1 mile south of Interstate Highway 10 and about 15 miles west of Blythe, California. Occupying 30 square miles (6 east-west x 5 north-south), the land is flat to slightly rolling, with a slight depression in the northeast quadrant and rising at 27 feet per mile to the Mule and Palo Verde Mountains to the southeast and the Little Chuckwalla Mountains to the southwest. The mean elevation is 500 feet above sea level. Figures 43 through 47 are aerial views of the site taken at an altitude of 1700 feet as the plane circled clockwise around it.

Figure 43 is a southward view as seen from the northwest corner of the site. This photo shows the rolling character of the land and the presence of abundant vegetation (bushes and trees) along the arroyos. The Little Chuckwalla Mountains are in the background. Figure 44 shows the entire Chuckwalla Valley area as seen from the northeast corner of the site.

Another view from the northeastern corner of the site is shown in Figure 45. This time, however, the camera is pointing south in line with the eastern edge of the site. Sand dunes are very evident in this quadrant.

Figures 46 and 47 show the Blythe South site as seen from the east and south, respectively. Dune sand and lines of relatively tall vegetation can be noted in places.

Ground reconnaissance of the area via Wiley Well Road extending south from Highway 10 through the center of the site revealed that the area has good solid footing except in dune sand which comprises about 20 percent of the land. Except in sand dunes in the north and southeast sectors, the soil is silty/sandy/gravelly overlain with bushes 3 to 6 feet in height.

Since wind velocities in this area exceed 17 mph 13 percent of the time, and

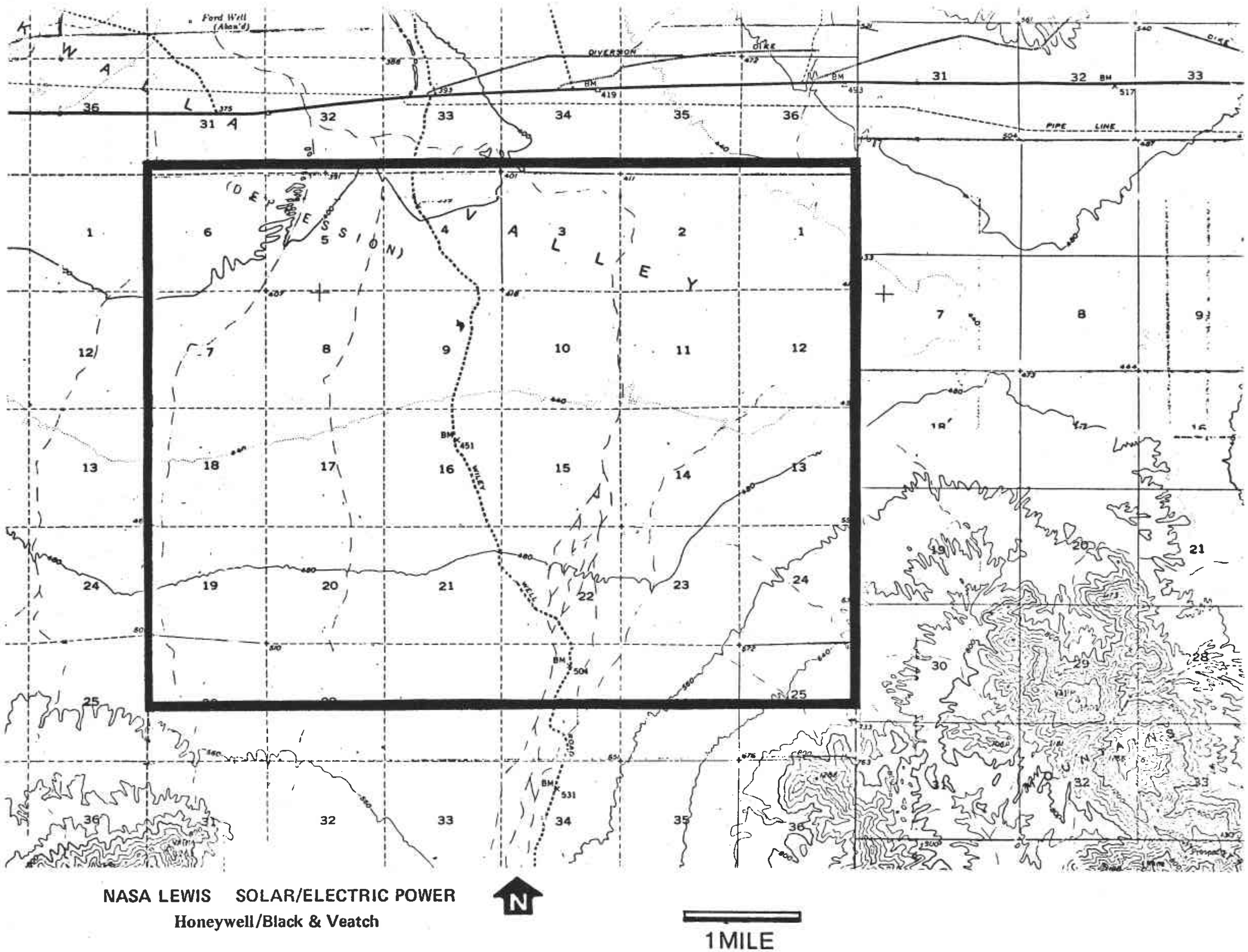

Figure 42. Blythe South site

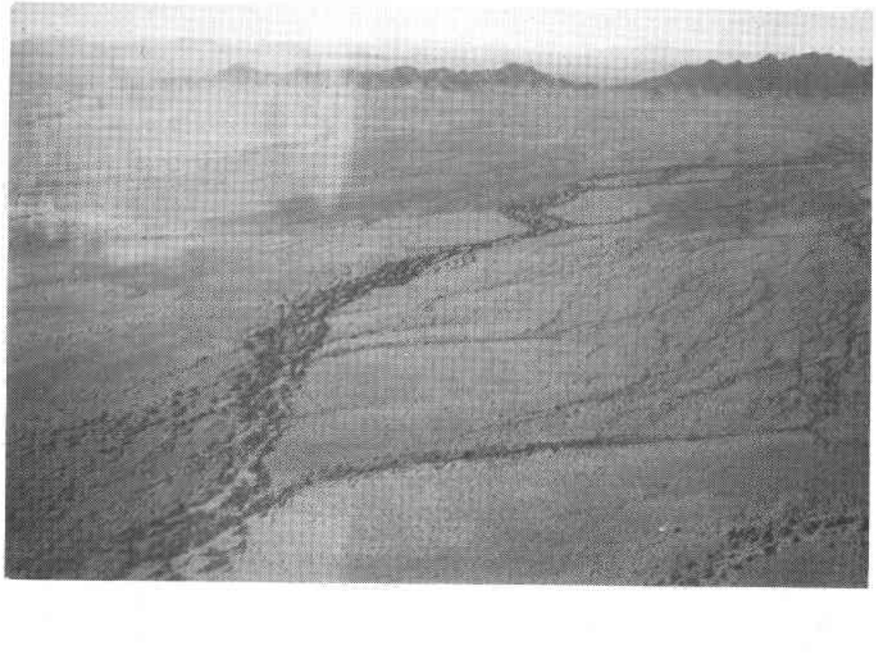

Figure 43. View looking south along western boundary of Blythe South site. Photograph taken from northwest corner of site.

Figure 44. View of Blythe South site looking southwest from northeast corner of site. Mule and Palo Verde Mountains are in background.

Figure 45. View looking south along eastern boundary of Blythe South site. Mule Mountains are in background.

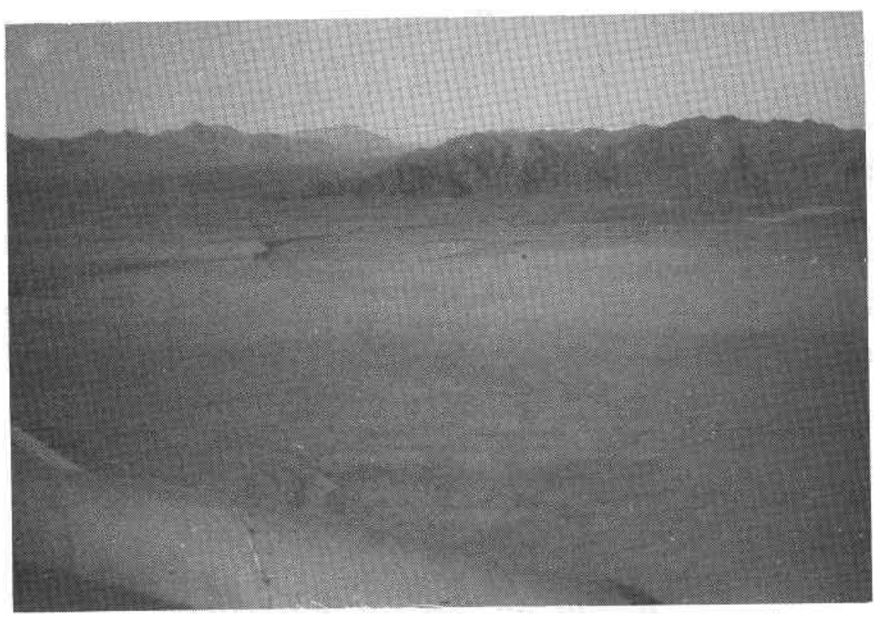

Figure 46. View looking northwest from eastern edge of Blythe South site. Palen Mountains are in background.

Figure 47. View looking north from southeast corner of Blythe South site. McCoy Mountains are in background.

32 mph 0.3 percent of the time,[5] dust/sand storms are to be expected, especially December through May. Clumps of bushy trees ranging to 20 feet in height were noted in the south central part of the area. Figures 48 and 49 show southeastern and northeastern views of the site as viewed from the center of the site. Ground conditions to the northwest and southeast were similar in appearance. However, dune sand was noted in the distance.

Figure 50 shows a view looking northeast along a dry wash at the point where the Wiley Well Road crosses the wash (about 1 mile from the southern boundary of the site). Notice the height of the mesquite trees and the shade they cast at this time of day (4:15 p.m., 10 December 1973). A view of the site along its southern boundary is shown in Figure 51. The terrain and soil conditions (well-compacted silt, sand, and gravel) appear to be favorable in this sector of the area.

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5. "Special Tabulations of Weather Data," Blythe, Calif., for period January 1949 through December 1954. U.S. Dept. of Commerce, Weather Bureau, National Weather Records Center.

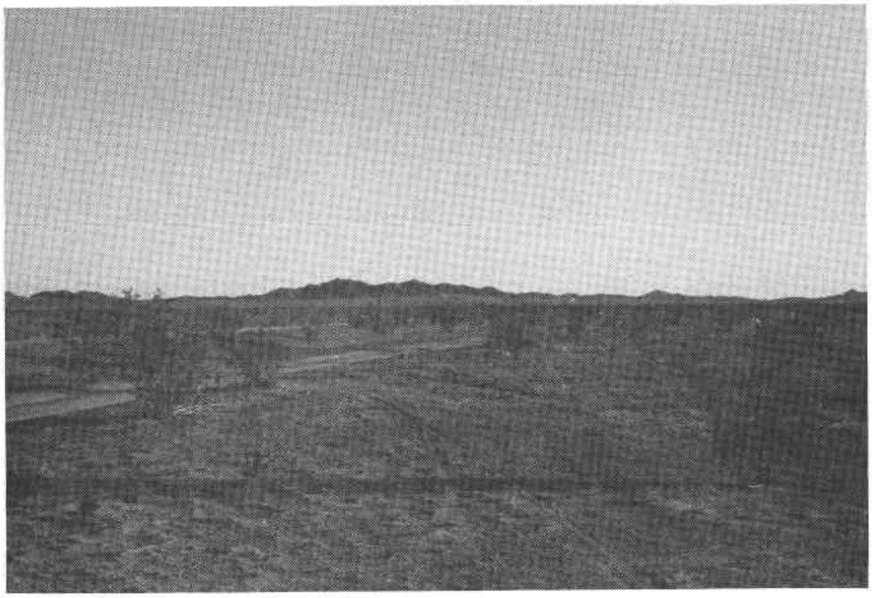

Figure 48. View looking southeast from center of Blythe South site toward Little Chuckwalla Mountains

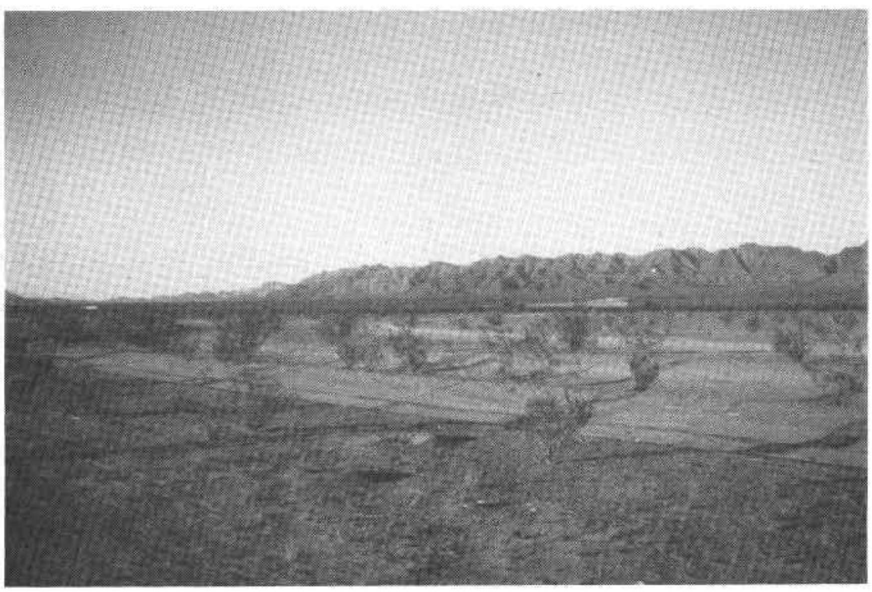

Figure 49. View looking northeast from center of Blythe South site across Wiley Well Road toward McCoy Mountains

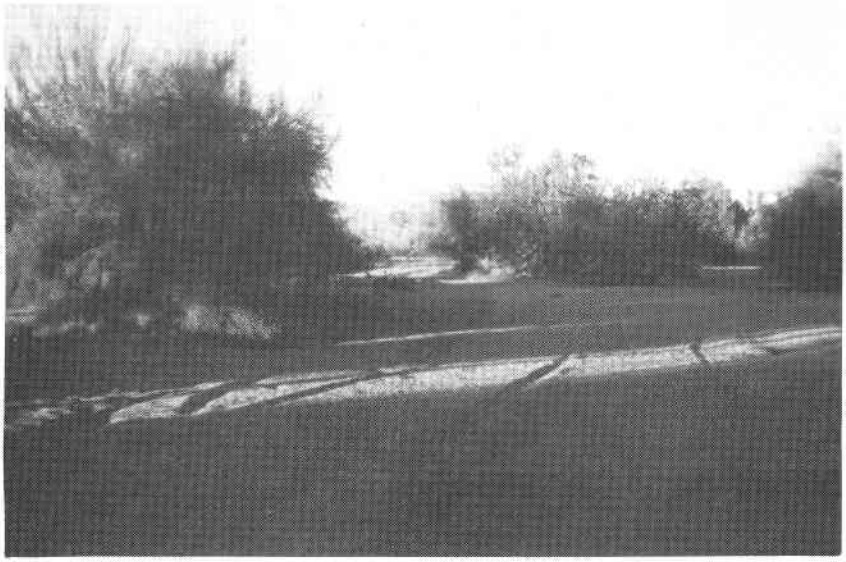

Figure 50. View looking northeast along dry wash (near Wiley Well Road and a point 1 mile north of southern boundary of Blythe South site)

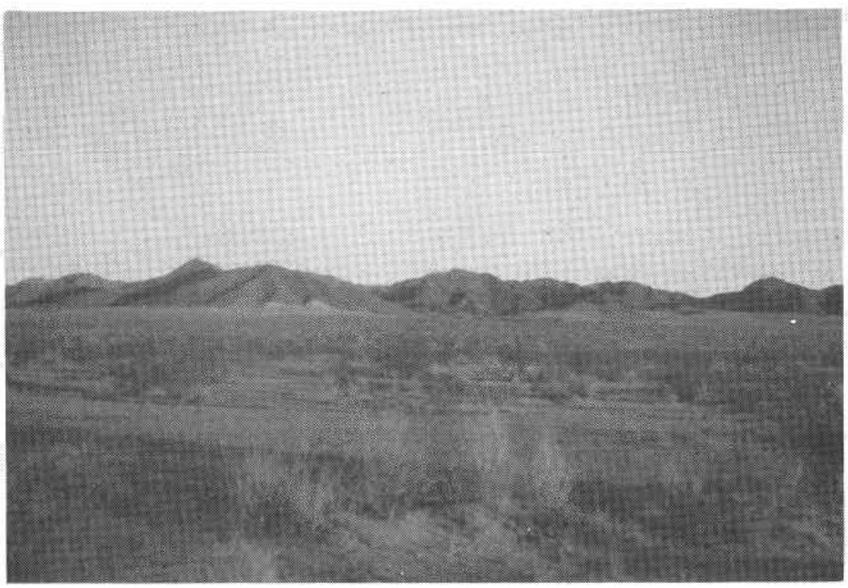

Figure 51. View looking east along southern boundary of Blythe South side. Mule Mountains are in background.

SECTION III
ANALYSIS OF OBSERVATIONS

The five candidate sites are described in Table 2 in terms of characteristics related to the seven major observable siting criteria. The plus (+) and minus (-) signs indicate, respectively, whether the characteristic described would promote or degrade the construction or operation of a solar power plant. The (X) indicates a fatal flaw -- a site characteristic which would prohibit plant operation. (Manix has a fatal flaw because the water supply is inadequate to supply a solar/electric power plant with conventional evaporative cooling towers.) A simple determination of the relative merits of the five sites can then be made by simply totaling the (+) and (-) signs. By so doing, it becomes clear, based on observations at the five sites, that the Inyokern South site is best by virtue of the most pluses (8) and the fewest minuses (4). It should also be pointed out that in contrast to the other sites, the minus factors associated with the Inyokern South site can be easily remedied. The lack of water at Manix, the industrial development at Searles, and the dust and sandstorm potential at Blythe are not so easily remedied. Some of these factors are discussed at greater length below.

THE DUST AND SANDSTORM FACTOR

As stated in the introduction, a major objective of this survey was to ascertain that no factor which might significantly influence the selection of one site over another was ignored. One factor, alluded to but never emphasized, was that the effect of dust and sand particles over a period of time, or even in just one severe storm, could seriously degrade the exposed surfaces (glass, plastic, and coated metals) of all collectors. The dust and sand particles could also hinder the operation of gears and other mechanical parts not properly shielded.

Table 2. Site Description Matrix

Criteria	Searles	Inyokern South	Manix	Blythe North	Blythe South
1) Insolation and Meteorology	(-) • Smoke plume (-){ • Ground fog • Inversion condition • Blowing dust may be problem	(+) Good	(+) Good	(+) Good (blowing dust/sand may be problem	(+) Good (ground fog observed in early evening)
2) Land Area and Topography	(+) • Flat (-) • Southwest corner more rugged	(+) • Gently sloping terrain to foothills (-) • Gulleys in area	(+) • Very flat (-) • Dune sand in southwest corner	(-) • Deep erosion (many gulleys) (+) Gentle slope to north	(+) • Very level • Abundant trees and bushes in washes (-) • 20 percent sand dunes
3) Land Use	(-) Industrial development and sediment tanks lie just north of site. Town of Westend within 1 mile.	(+) A few uninhabited residential structures and an abandoned gas station only signs of development.	(-) • Irrigated land and development noted in southeast area	(+) Undeveloped	• Buried pipeline along northern border (gas) (-) • Wiley Road is public access to campground south of site
4) Soils/Geology	(-) Alkali dust prevalent	(+) • Firm sand and gravel (-) • Abundant low bushes, including cacti and Joshua trees	Lake bed contains salt deposits	(-) • Fine sand, uncompacted (-) • Poor foundation soil (-) • Widely scattered low (1 to 3 feet) bushes	(+) • Silt/sand/gravel (-) • 20 percent dune sand (-) • Scattered bushes (3 to 6 feet) and trees in arroyos
5) Water Source	(-) • No surface water observed (+) • Los Angeles aqueduct diversion possible	(-) • No surface water observed (+) • Physically possible to access Los Angeles aqueducts (underground at most points)	(-) • No surface water (-) • No other water sources observed (X)	(-) • No surface water (+) • Colorado River within 25 miles of site • Surface water from mountains ocassionally available	(-) • No surface water (+) • Colorado River within 15 miles of site • Occasional surface water runoff available
6) Transportation Access	(+) • Highway 178 (+) • Trona Railroad runs north-south at west side of site	(+) • Highway 14 (+) • Southern Pacific RR at Inyokern	(+) • Interstate Highway 15 adjacent to area (+) • UP Railroad 6 miles distant	(+) Adjacent to Interstate Highway 10 (within 5 miles)	(+) Adjacent to Interstate Highway 10 (within 1 mile)
7) Electric Transmission	(+) • 115-kilovolt AC line from Inyokern to Westend (-) • 120 miles to nearest load center	(+) • Observed 800-kilovolt DC and 230-kilovolt AC lines (-) • 100 miles to nearest load center	(+) • 230-kilovolt AC (two transmission lines) -- Hoover Dam to Los Angeles (-) • 150 miles to nearest load center	(-) • 150 miles to nearest major load center	(-) • 150 miles to nearest major load center

Sand and silt were noted to be present at all sites surveyed. Ground reconnaissance at Inyokern South and the two Blythe sites showed sand predominating over silt and dust; and soil-holding vegetation (bushes) to be quite dense at Inyokern. At Blythe (particularly Blythe North), sand was finer in texture, silt more prevalent, and bushes less abundant -- these factors all contributing to the loose character of the soil.

Wind velocities of about 35 mph are required to raise sand grains (0.01 to 1.00 mm in diameter) off the ground while only about 17 mph is required to raise dust particles (0.0001 to 0.01 mm in diameter) off the ground.[6] Since wind velocities at both places exceed 17 mph about 13 percent of the time and 35 mph about 0.3 percent of the time, the silt/dust problem is seen to be the more persistent, particularly at Blythe. The sandstorm problem, while infrequent, could cause extensive damage to equipment at both places during peak gusts to 70 mph.

ENVIRONMENTAL COMPATIBILITY

All sites surveyed were observed to satisfy the environmental criteria set forth previously under this contract. These include the avoidance of:

- Urban areas
- Agricultural areas
- Pipeline right-of-way
- Indian land
- Wildlife reserves and sanctuaries
- Commercial and industrial activities
- Future urban or agricultural growth areas

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[6] AR705-15. Research and Development of Materiel: Operation and Development of Materiel under Extreme Climatic Conditions; subheadings j and k, pp. 19, 20.

- National, state, and local parks
- Recreational areas of all kinds

On the basis of surface condition, availability of water, and access to transmission facilities and transportation means (air, road, rail), Inyokern South was observed to be satisfactory in all categories. The other sites were observed to be unsatisfactory in one or more categories. For example, Searles is too near industrial development and is dusty; Manix has an inadequate water supply (not easily remedied); Blythe sites, while having a potentially adequate water supply (the Colorado River), are deficient in soil conditions (silty/sandy and conducive to dust storms) and proximity to transmission facilities and/or load centers.

Solar plants are no more harmful to the ecological system than any other clean operation of similar configuration. At these sites the effect on the local biota is considered even less harmful in view of the relatively small area involved and the paucity of both plant and animal life at all candidate sites.

Vegetation will not be adversely affected except for that portion downtrodden during construction (roads and working areas) and the small amount replaced by the bulk of the solar power plant. In the area encompassed by the collector field, it is likely that plant life will actually be enhanced due to rainwater runoff as well as the periodic shade afforded as the sun moves across the sky.

None of these areas is valued as historical, archaeological, or scenic sites (i.e., no one visits these areas specifically to revere, excavate, or revel in the scenery). Consequently, no detrimental impact upon aesthetics is anticipated. The solar plant will nonetheless be designed to blend well with the environment and to be aesthetically pleasing since, in view of anticipated scientific and public interest, the project is likely to attract many visitors.

SECTION IV
CONCLUSIONS

This one-day photographic survey of five candidate sites in four locales revealed Inyokern South to be the best choice for the site of a central solar/electric power station based upon observable data. [It was determined previously that it is also the best choice based on such nonobservable data as solar insolation, climate, and low population density within 10 miles of the site. Data not considered include Government regulations (e.g., water rights), seismic disturbances, and economic considerations such as land value.]

The observable data include each candidate site's observed compatibility with the environmental criteria specified in an earlier report and the following major siting criteria:

- Water supply
- Land area and topography
- Land use
- Transmission lines (access to)
- Transportation means (highways, railroads)
- Ground conditions (soils, geology)
- Flora and fauna
- Aesthetics

Based on the small area involved, the minimal plant and animal life observed (no rare or endangered species),* the questionable scenic value of the area,

* With the possible exception of the Mojave ground squirrel.

and the known clean nature of solar energy, it is concluded that a solar power plant erected on the Inyokern South site will have a negligible effect upon the ecological balance and aesthetic value of the area.